



# B: Design Guidelines

Sanford Creek Greenway

## Chapter Outline:

### Introduction

### Wayfinding and Signage

### Greenway Trail Types

### Ancillary Trail Facilities and Amenities

## INTRODUCTION

This chapter provides guidelines to both public and private entities for the future development of the Wake Forest Open Space & Greenway Plan. The guidelines noted herein are based on the best practices in use throughout the United States, as well as accepted national standards for greenway facilities.

The guidelines should be used with the understanding that each greenway is unique and that design adjustments will be necessary in certain situations in order to achieve the best results. Each segment should be evaluated on a case-by-case basis, in consultation with local or state bicycle and pedestrian coordinators, a qualified engineer and a landscape architect.

Facility design is a broad topic that covers many issues. This section provides guidelines for typical greenway facilities and is not a substitute for more thorough design and engineering work. For more in-depth information and design development standards, the following publications should be consulted:

*Greenways: A Guide to Planning, Design and Development*; Published by Island Press, 1993; Authors: Charles A. Flink and Robert Searns

*Trails for the Twenty-First Century*; Published by Island Press, 2nd ed. 2001. Authors: Charles A. Flink, Robert Searns, Kristine Olka

*Guide to the Development of Bicycle Facilities*; Updated in 1999 by the American Association of State Highway Transportation Officials (AASHTO).

*Manual on Uniform Traffic Control Devices (MUTCD)*; Updated in 2003. Published by the U. S. Department of Transportation, Washington, DC

*Universal Access to Outdoor Recreation: A Design Guide*; Published by PLAE, Inc., Berkeley, CA, 1993

In all cases, the recommended guidelines in this report meet or exceed national standards. Should these national standards be revised in the future and result in discrepancies with this chapter, the national standards should prevail for all design decisions.

### **ADA REQUIREMENTS**

The Americans with Disabilities Act requires that portions of the greenway be accessible to persons with varying motor skills and abilities. Perhaps the best way to comprehend the importance of ADA is to understand that most of us, at some time in our life, will experience a temporary disability which will affect the way in which we make use of outdoor resources. ADA benefits all Americans by making the outdoor environment more accessible.

### **RECYCLED MATERIALS**

The consultant recommends the use of recycled waste materials and products in the construction of all signage for the project. Recycled waste materials offer design versatility, often have a long life span, and require less long-term maintenance than similar products constructed from natural materials. Recycled plastic lumber and or concrete can be used for the construction of posts and poles, and recycled aluminum can be used for signs.

## **WAYFINDING AND SIGNAGE**

A comprehensive system of signage is recommended throughout the Town of Wake Forest to ensure that information is provided to trail users regarding the safe and appropriate use of all facilities, both on-road & off-road. It is essential that the future trail network be signed seamlessly with other alternative transportation routes, such as designated bicycle routes, historic and/or cultural walking tours, and wherever possible, bus routes including the Wake Forest Loop and the Wake Forest-Raleigh Express.

Signage includes post- or pole-mounted signs and pavement striping. Signage is also divided into orientation and interpretive signs, regulatory signs and directional signs. Example language for trail user rules and regulations is provided in Appendix D: Operations and Management (pages D-4 to D-5), and should be provided at trail heads (see signage example image on page B-3, 'Orientation and Interpretive Information').

*Below: An examples of signage from the Wake Forest Greenway System*





Trail Identity Logo



Orientation and Interpretive Information



Regulatory Information



Directional



Description

A Wake Forest Greenway logo should be developed and used to aid in reinforcing the trail’s identity. Signage should be simple, direct, and easy to identify. Trail logo examples are shown at left.

Recommendations

Logos should be used as a consistent element throughout the length of the trail, and in printed trail information, such as brochures and maps.

This type of signage includes easy to read and comprehend information about the trail.

Orientation maps should clearly indicate landmarks and distances of trails. Maps should also identify the area they are placed.

As part of the trailhead, the overall design of this type of sign is the first experience most visitors will have with the trail. The design and information this sign communicates will establish the trail identity and help to create a more unified, pleasurable experience.

Interpretive information includes but is not limited to: history of the area, environmental information (plant, wildlife, river ecology), river restoration processes, and/or other important trail related or educational information.

Regulatory signage states the rules of the trail. Regulatory information should be located at every trailhead, access parking lot, and in areas where users need to pay attention to environmental conditions.

Regulatory signage should be developed to conform to the (2001) Manual on Uniform Traffic Control Devices and the American Association of State Highway Transportation Official Guide for the Development of Bicycle Facilities.

Directional signage consists of arrows that direct users to or from a trailhead or to amenities along the greenway.

These should be used in conjunction with the Way-finding Logo. They are a crucial part of the off-trail signage system.

## GREENWAY TRAIL TYPES

The Town should consider trail surface and width during design, two variables that will greatly affect the cost of installing and maintaining this system. When determining the width of greenways the Town should consider the safety of the user groups for which the trail will be built. A minimum trail width of 10' is standard in North Carolina for trails intended for bicycle use (not including mountain biking trails, which can be much narrower). This allows enough room for bicyclists traveling in opposite directions to pass each other comfortably. Other recommended trail widths vary, depending on the intended uses.

The following typology of greenway trails assist in defining and designing future greenway projects for the Wake Forest system. The selection of the appropriate type depends on anticipated use, topography, hydrology, existing road access and a host of other factors. Construction methods for specific trail types may vary between areas in the region depending on local environmental conditions and user requirements.

### *TYPE 1: NO FACILITY DEVELOPMENT*

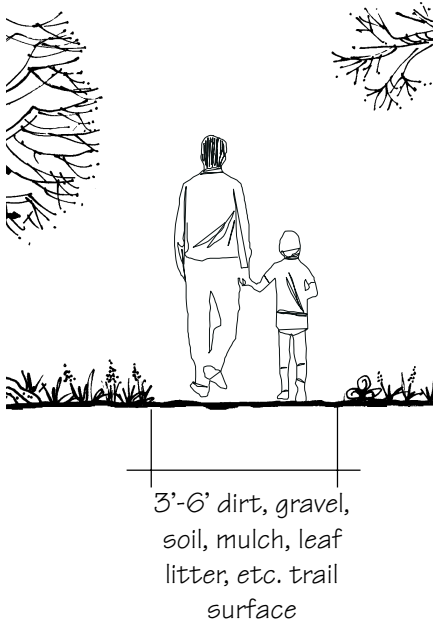
This designation applies to corridors containing significantly environmentally sensitive areas, such as steep slopes, wetlands, or other environmental constraints that make trail facilities undesirable or impractical. Where no facility is to be developed, the area will remain in a natural state and human access will be extremely limited. No support facilities or amenities are recommended in environmentally sensitive areas, and hikers should be encouraged to stay on designated footpaths, if they are allowed at all. Other functions for these corridors include floodplain management, water quality protection and conservation of important habitat for wildlife and plants.

### *TYPE 2: LOW-IMPACT USES, LIMITED DEVELOPMENT*

Type 2 Trails have a great deal in common with Type 1. Both emphasize harmony with the natural environment, preserve natural resources, and mediate between larger habitat areas, open space, and corridors for wildlife. Type 2 trails differ in that they allow for more access for trail users, providing a valuable link to tie park components together, forming a cohesive trail system.

Type 2 corridors contain environmentally sensitive features that limit the extent of greenway facility development. These corridors remain primarily in a natural state, with gravel, or dirt trails (two-feet to six-feet wide) for use by low impact user groups such as hikers or joggers, and are not intended for bicyclists or other wheeled users. These paths sometimes follow strenuous routes and may limit access to all but the most mobile users. Construction of these trails consists of providing positive drain-

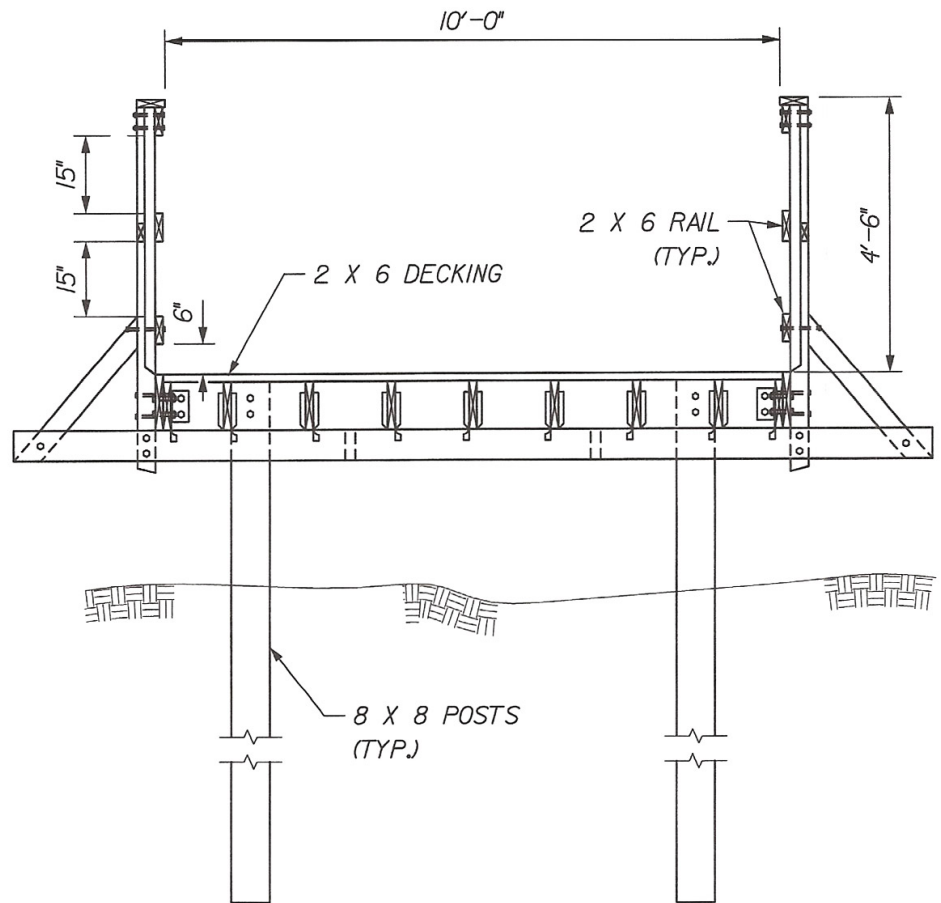




*Above: A diagram and picture of a typical dirt trail; and a picture of boardwalk trail along the Sanford Creek Greenway*

age for the trail tread and should not involve extensive removal of existing vegetation. Corridor widths totaling 200 feet are considered optimal with 50 feet usually considered the minimum. Trailhead facilities and other amenities will be limited, though some features such as signage and boardwalks may be necessary.

Boardwalk or wood surface trails are typically required when crossing wetlands or other poorly drained areas. While boardwalks can be considered multi-use trails, the surface tends to be slippery when wet. They are constructed of wooden planks or recycled material planks that form the top layer of the boardwalk. The recycled material has gained popularity in recent years since it lasts much longer than wood, especially in wet conditions. A number of low-impact support systems are also available that reduce the disturbance within wetland areas to the greatest extent possible.

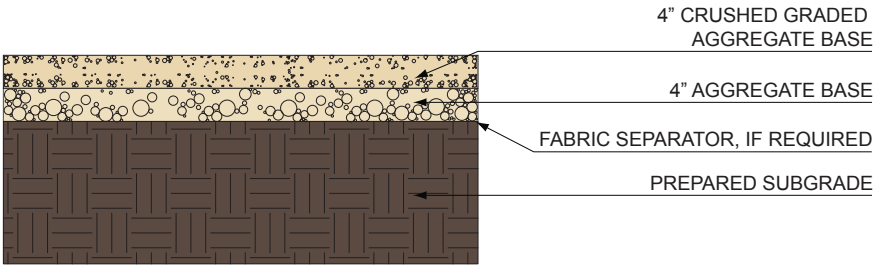


1. When the height of a boardwalk exceeds 30", railings are required
2. The thickness of the decking should be a minimum of 2"
3. Decking should be either non-toxic treated wood or recycled plastic.
3. The foundation normally consists of wooden posts or auger piers (screw anchors). Screw anchors provide greater support and last much longer.
4. Opportunities exist to build seating and signage into boardwalks.
5. In general, building in wetlands should be avoided.

**TYPE 3: MULTI-USE, UNPAVED TRAIL DEVELOPMENT**

Aggregate surface trails (10 feet minimum width) are appropriate for corridors outside the floodplain where anticipated use or the adjacent landscape dictates a more natural trail. Unpaved trails are not recommended in areas that experience frequent flooding because the aggregate surfaces wash away, degrading water quality and requiring reapplication of the surface material.

Regardless of their location, unpaved trails typically require more frequent repairs. Even when located outside of the floodplain, the aggregate trails should be designed to provide for proper drainage (it is best if water is channeled beside the trail rather than allowing it to cross the surface). Materials that can be used to surface a Type 3 Trail include, soil cement, compacted limestone screenings (crusher run), and crushed stone.



GRAVEL PAVING ON AGGREGATE

Careful consideration should also be given to the amount of traffic the specific segment will generate, since these surfaces tend to deteriorate with excessive use. The type of traffic on these trails is limited to pedestrian and bicycle activity. Wheelchair users and persons with strollers can use unpaved trails if they are designed to ADA standards and surfaced with compacted limestone screenings or other hard, permeable surface, crushed stone. Trailhead facilities and other amenities (such as benches, signage and picnic tables) are appropriate with this type trail and will be developed as needed and where desirable.

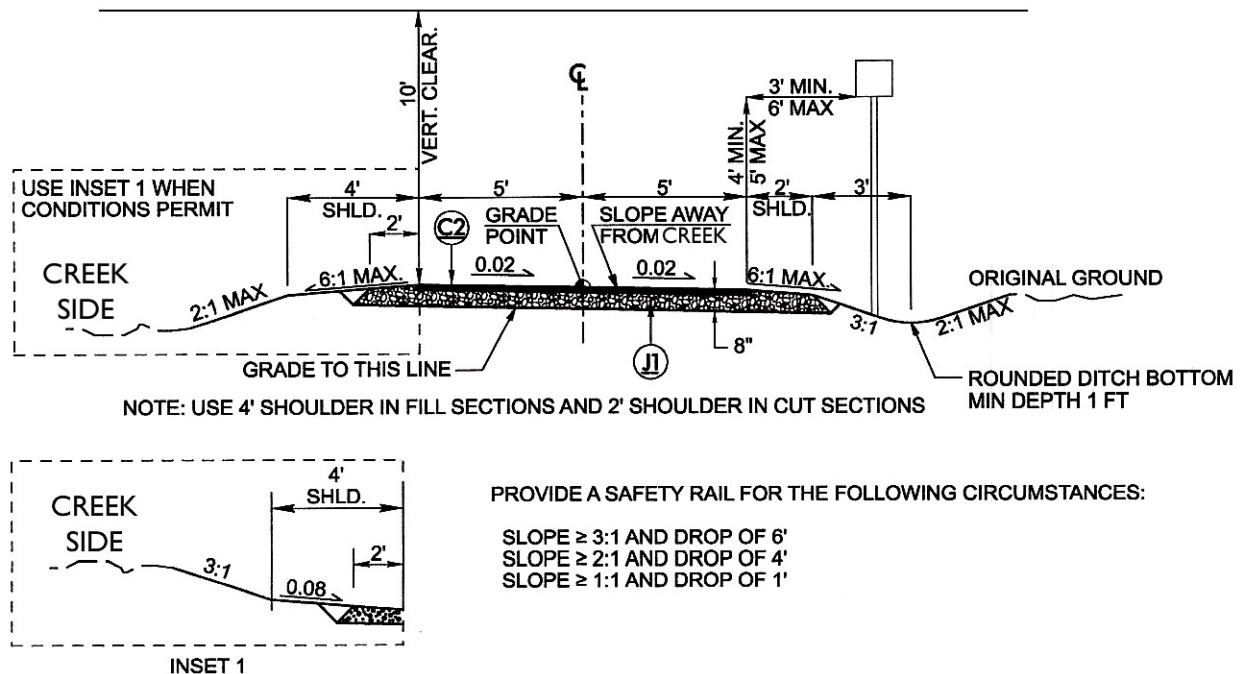




#### TYPE 4: MULTI-USE, PAVED TRAIL DEVELOPMENT

This designation applies to high capacity corridors, that do not contain environmentally sensitive areas, will most likely be used as transportation routes, and/or are located within frequently flooded areas. The paved trails can be surfaced with asphalt or concrete (minimum 10-foot wide) for use by several user groups, including bicyclists, joggers, wheelchair users and rollerbladers. Although asphalt is the most common paved surface used for greenway trails, concrete is best for areas experiencing frequent flooding because of its durability. Trailhead facilities and other amenities will be developed as needed and where appropriate.

Typical pavement design for paved, off-road, multi-use trails should be based on specific loading and soil conditions found on site. They should be designed to accommodate access by maintenance and emergency vehicles in both width and loading.



Asphalt is a popular trail surface in the region. It is highly flexible, relatively inexpensive to lay and holds-up well over time. One concern with asphalt is the deterioration of trail edges. This condition can be reduced through the installation of geotextile fabric under an aggregate base and the provision of two-foot shoulders. There are many cases in the metropolitan area, however, where asphalt is installed directly on compacted subgrade and performance is acceptable. It is important when omitting the aggregate base to pay close attention to subsurface conditions and drainage to insure a stable subgrade prior to paving.

The minimum width for a two-directional trail is 10 feet. Centerline stripes should be considered for paths that generate substantial amounts of traffic. Possible conflicts between user groups must also be considered during the design phase since cyclists often travel at higher speeds than other modes.



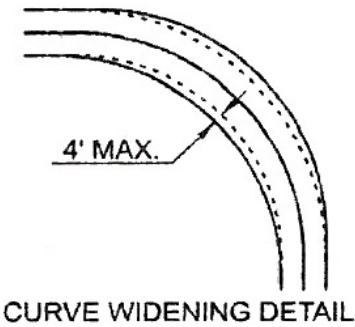
TYPE 4: MULTI-USE, PAVED TRAIL DEVELOPMENT (CONTINUED)

General Characteristics:

Designed for:	Two-way, multi-purpose travel.
Recommended minimum width:	10 ft.
Recommended minimum design speed:	20 mph.

Horizontal Alignment:

Cross Slope:	2%
Minimum Radius:	95 ft. *



\* Where a sharper curve radius is needed, curve widening will be provided to either the outside or the inside of the curve, per the detail shown. Curve warning signs and pavement markings shall also be used in accordance with MUTCD Standards.

Sight Distance:

See AASHTO Guidelines, Table 3 (page 44) and Table 4 (page 46) for stopping sight distances.

HYDRAULIC DESIGN CRITERIA

Typical C Values

SURFACE	C VALUE
Woods	0.200
Grass	0.350
Single Family Residential Dev.	0.450
Multi-Family Development	0.600
Business Development	0.600-0.800
Pavement/Building	0.900

Typical n Values

SURFACE	n VALUE
Pavement/Roofs Surface Flow	0.011
Concrete Pipes	0.013
Curb & Gutter	0.013
Grass Ditch > 0.7'	0.050
Grass Ditch < 0.7'	0.070
Existing Ditches	0.080
Grass Surface Flow	0.240
Woods Surface Flow	0.400
Rip Rap Class A	0.350
Rip Rap Class B	0.380
Rip Rap Class I	0.400
Rip Rap Class II	0.420

TYPICAL DIMENSIONS AND VALUES

Sheet (Overland) Flow

Maximum Flow Length:	300 ft.
Travel Time:	10 minute minimum
P (2 year/24 hour)	3.6 in.

Storm Channel Design

Minimum Ditch Slope:	0.50%
Ditch Protection Design Flow:	2 year
Storm Ditch Depth:	1 ft. minimum (designed for overtopping in undeveloped areas)
Storm Ditch Depth	10 year (designed for developed areas)

Ditch Liner Types

Class C Vegetation PSS:	1 lb./ft <sup>3</sup>
PSRM PSS	2+ lb./ ft <sup>3</sup>
Rip Rap	Variable

### *Storm System & Culvert Design*

Minimum HDPE Culvert Size:	12 in.
Maximum HDPE Culvert Size:	60 in. (size required above 60 in. will default to bridge standards)
Minimum RCP Culvert Size:	18 in.
Minimum Culvert Slope:	0.25%
Minimum Pipe Cover (trail):	2 ft.
Minimum Pipe Cover (natural):	1.5 ft.
Culvert Design Flow:	10 year
Culvert Overtopping Flow:	25 year
Perennial Stream Design Flow:	25 year
Perennial Stream Overtopping Flow:	25+ year
Outlet Protection Design Flow:	10 year

Provide 0.5 ft. minimum from hydraulic grade line to top of inlet grate or junction box.

### *Trial Size Culvert*

A trial size culvert can be determined using the design discharge and an assumed  $HW/D = 1.2$

Head walls on inlet end only.

48 in.	Cost/ft.
54 in.	Cost/ft.
60 in.	Cost/ft.
Stream Impacts	Cost/ft.

### *Storm Drain Pipes*

Storm drain pipes should be concrete, unless a site limitation (such as grade or corrosive conditions) dictates the use of an alternative material. The minimum pipe size to serve a single inlet is 12 in. For more than one inlet, or a length of more than 100 ft. a 15 in. pipe is the minimum size. Stream crossing culverts will utilize HDPE piping.

### *Bridge Length & Height*

Bridge minimum length will be based on a 10 ft. setback from the Top of Bank. Bridge minimum height to low cord will be 2 ft. above Design Flow. Overtopping of bridge structure will be acceptable. No bridge piers in the Channel.

### *Cost Analysis & Stream Impacts*

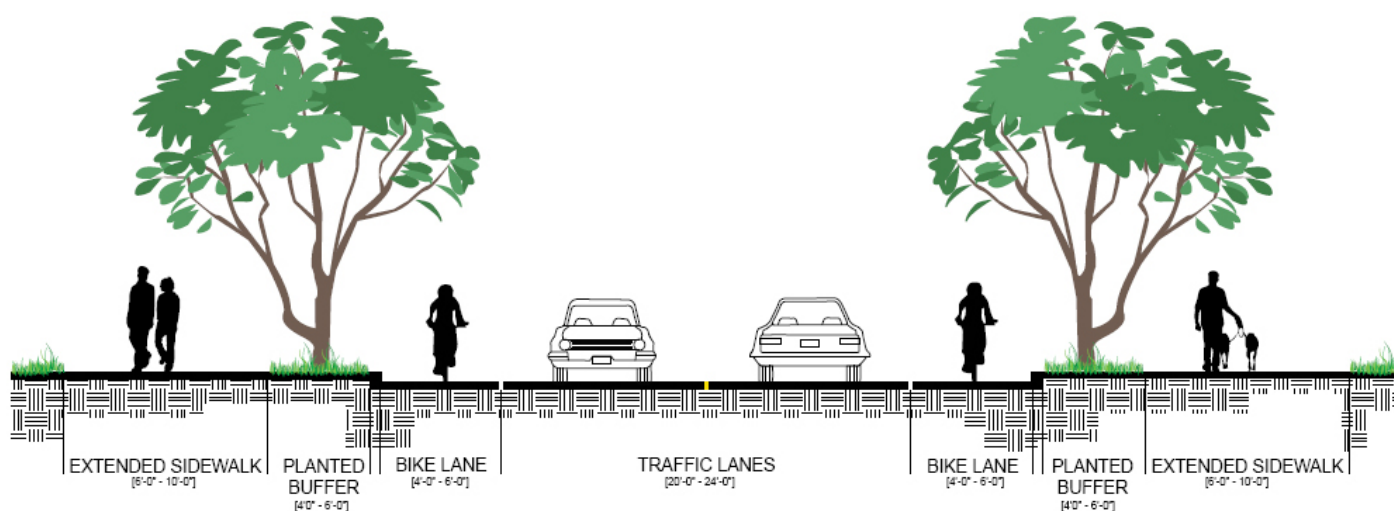
A cost analysis and stream impacts comparison will be done at all Perennial Stream crossings to determine the crossing structure type. Hydraulic opening will govern over all else. Cost analysis will be the second highest parameter. Preferred alternatives will be based on 1) bridge, 2) culvert, and 3) trail relocation. When multiple alternatives satisfy all control factors, an analysis shall be performed to ensure the alternative selected is the least costly in terms of construction, maintenance, and operations. Boardwalk will be used in low flow situations where scour is not a concern, such as in wetlands and sheet flow situations. Where culvert crossings result in an unacceptable back water condition, bridge crossings shall be utilized. Back water conditions will be studied on a case by case basis to determine what is and what is not acceptable based on geographic parameters.

### *Natural Channel*

To the greatest extent practicable, bridge crossings will be designed to accommodate the natural channel.

### ***TYPE 5: ROADWAY CORRIDOR (SIDEWALKS AND BICYCLE FACILITIES)***

This trail type has perhaps the most variation of use and construction. This designation applies to corridors in urbanized or urbanizing areas where an off-road option is not possible. Such corridors function as connections between off-road trails and major origins and destinations. This category includes both sidewalks for pedestrian use and bicycle facilities for cyclists. Bicycle facilities can vary from bicycle lanes to paved shoulders to wide curb lanes (see the Town of Wake Forest Bicycle Plan for design guidelines on bicycle facilities). Pedestrian scale lighting, street trees, benches and other amenities should be developed to encourage sidewalk use (See the Town of Wake Forest Pedestrian Plan for design guidelines on pedestrian facilities).



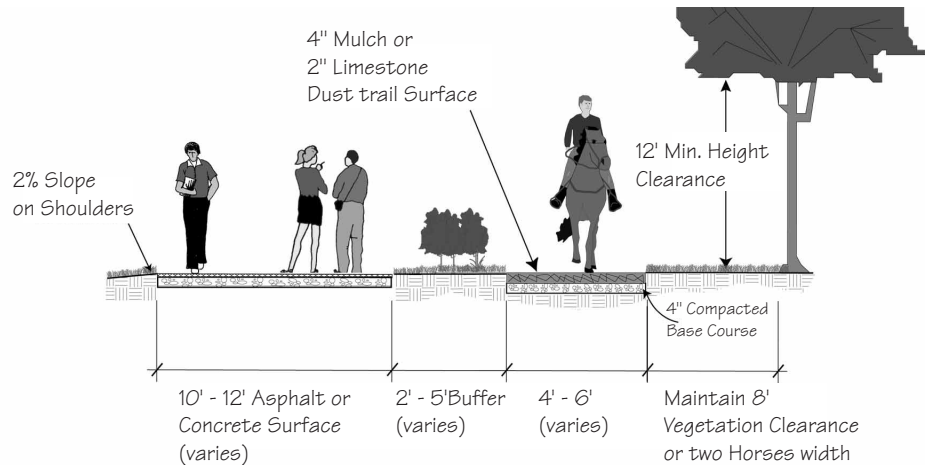


## EQUESTRIAN TRAILS



*Signs indicating that equestrians have the right-of-way should be posted on the trail, as seen in these examples.*

There is an active equestrian community in Wake Forest, particularly in the area east of the reservoir, which has expressed an interest in developing equine trails. Equestrian trails need to be separated from facilities that are used by pedestrians and cyclists. Equestrians tend to prefer longer segments of trails to ride. Wake Forest may wish to explore the possibilities of a shared facility with the towns of Rolesville, Wendell, and Zebulon. This would enable the trail to span a greater distance, connect the different towns, and create an opportunity for the towns to share in the investment of a stand-alone equestrian trail or one that parallels a pedestrian and bicyclist trail.

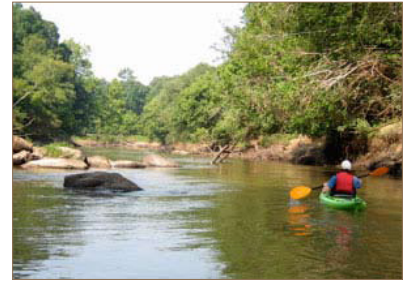


- Dirt or stabilized dirt is a preferred surface. Crushed granite screenings are also acceptable. Hard surfaces like asphalt and concrete are undesirable for equestrians because they can injure horses' hooves. Granular stone may also present problems because loose aggregate can get stuck in hooves.
- Within the tread, large rocks, stumps, and other debris should be cleared.
- Sight distances for equestrians, who usually travel between 4 and 6 miles per hour, should be at least 100 feet.
- Hitching posts should be installed at rest stops, picnic areas, and rest rooms.
- For horseback riders, a water crossing is preferred to a high and narrow bridge. If erosion is a concern, or if water crossing is for some reason undesirable, then provide mounting blocks at the bridge, so riders can dismount and lead their horses.
- Equestrians should be expected to remove their horse's manure from trail surfaces. Many riders are not comfortable dismounting and taking care of this as it occurs. Therefore, equestrians should be strongly encouraged (or possibly required in exchange for use of the trail) to join fellow riders on manure clean-up days.

## WATER BASED TRAILS

This designation applies to those rivers and streams that can successfully accommodate and/or which are designated to support canoeing, kayaking and boating. Water based trails can be designated with features and facilities that make this activity more enjoyable for residents, including signage systems, improved rapids, safety systems, and access points. Rental outfits could be established at put in/take out points.

- Clearly marked access points and/or trailheads should be provided.
- Educational signs, directional signs, and regulatory signs should inform users of their surroundings and how to navigate the watercourse safely.
- The provision of designated picnic areas and camp sites along water trails can reduce the problem of trespassing private property along the watercourse.
- If a pathway from parking area to water access exceeds 1500 feet, a permanently affixed canoe or kayak stand should be positioned every 1000 feet.
- Informational signs containing emergency contact numbers, as well as contact numbers for the managing partner, must be displayed at the parking space area and/or within 150 feet of the access site.
- Access to waterway must be firm, compacted, and permanently delineated
- Minimum construction for facilities
- Lights in parking and picnic areas are recommended
- Maps should be provided to guide users along the watercourse and to access sites for drop-in and take-out.
- Natural but well maintained pathway from parking to water access:
  - Pathway at least 6' wide
  - Grass not higher than 5"
  - Tree overhang not lower than 14'
  - Grade must not exceed 20%





## MAJOR AND MINOR TRAILHEADS

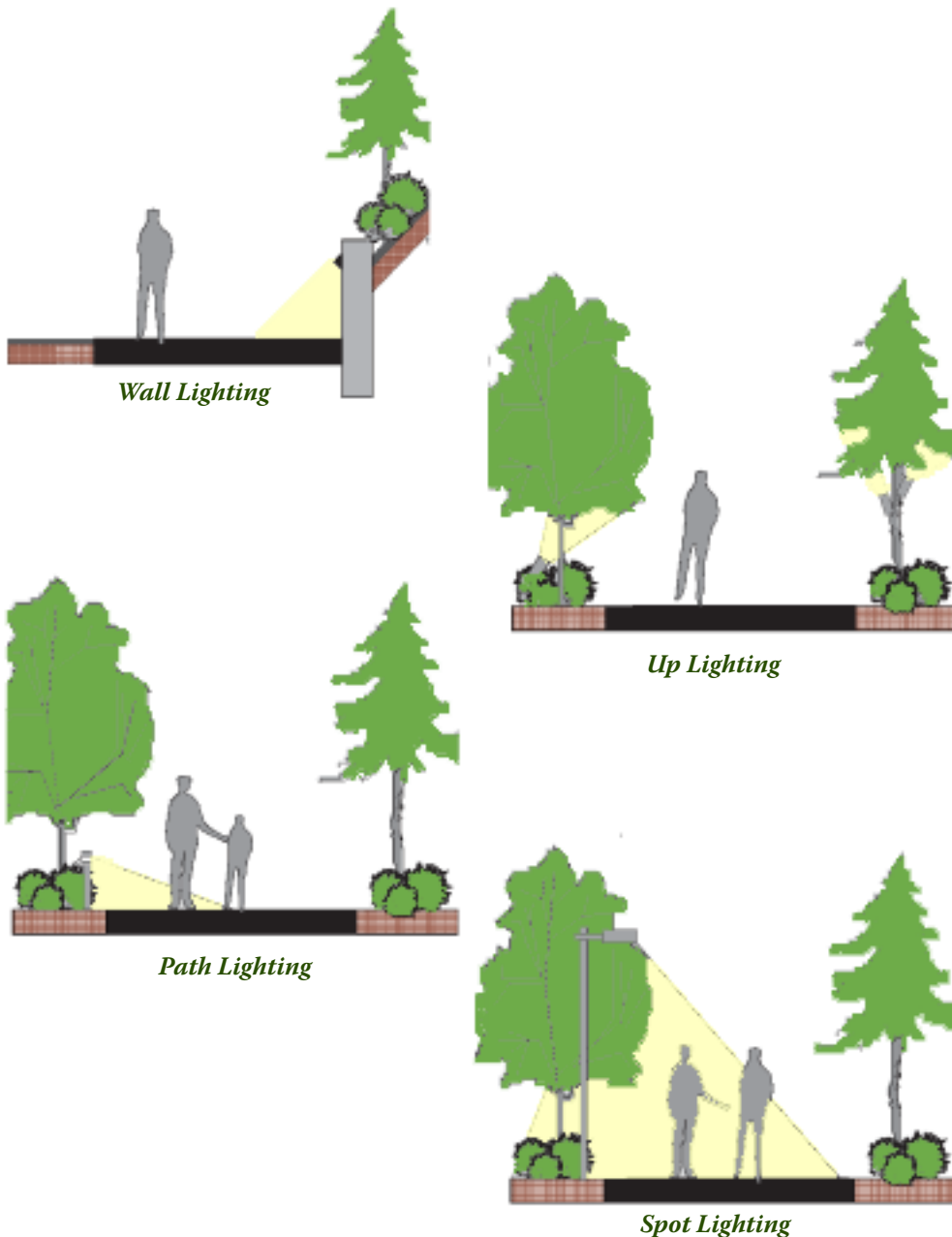
Trailheads should be installed throughout the greenway system to give the public access. A “trailhead” is a point of formal public entry into the greenway system that may provide certain related public facilities such as parking, restrooms, drinking fountains, trail signage, etc. Major trailheads and minor trail heads are suggested. Major trailheads should be located in significant areas. An exhibition building or an interpretive exhibit may be incorporated, along with restrooms, water fountains, picnic tables, parking, signage, etc. Minor trailheads can be used to connect a smaller number of people to surrounding trails, open space, parks, etc.





## TRAIL LIGHTING

Particularly during winter months when trips to and from work are made in the dark, adequate lighting can make the difference in a person's choice to bicycle or walk. Still, due to liability and security concerns, many off-road bicycle paths are closed at night, and therefore unlit. However, main trial corridors should be considered for later evening use, even if unlit (for example the American Tobacco Trail in Durham, NC is unlit and remains open until 10 PM for use by commuters.) Lighting for multi-use trails should be considered on a case-by-case basis in areas where 24-hour activity is expected (such as college campuses or down- town areas), with full consideration of the maintenance commitment lighting requires. A licensed and qualified lighting expert should be consulted before making any lighting design decisions. Doing so should reduce up-front fixed costs as well as long-term energy costs.



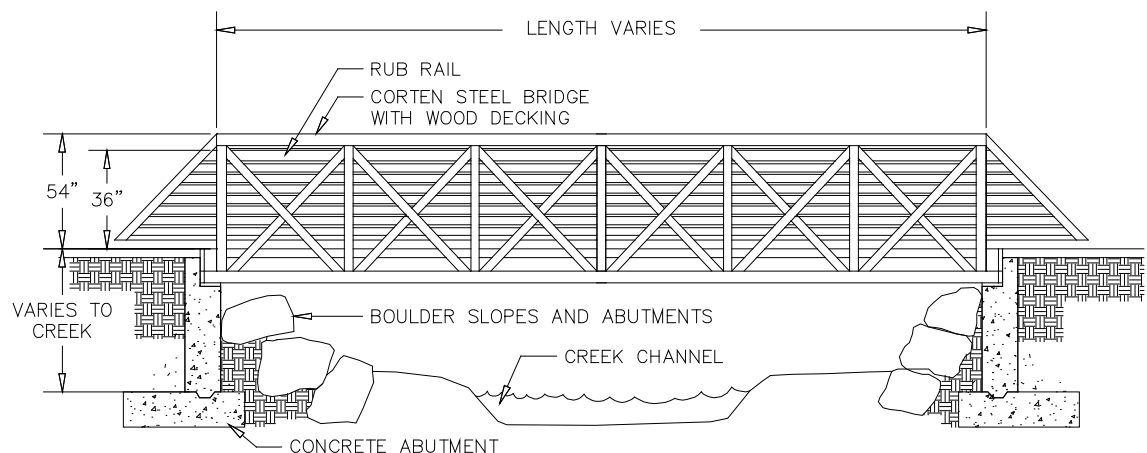
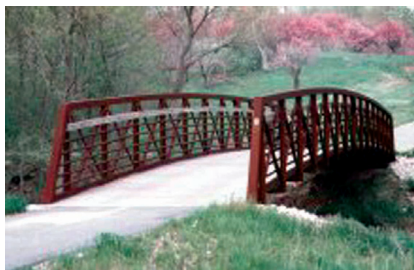
*Left: Spot lighting is typically employed in high use areas such as an esplanade or where a trail meets a parking lot or other urbanized area. Path lighting can be used to guide individuals along a trail to a specific location.*

## FOOTBRIDGES

Footbridges are used where the span of a waterway is too large for culverting, where there is a wetland type area, or to cross the river. The type and size of bridges can vary widely depending on the trail type and specific site requirements. Some bridges often used for multi-use trails include suspension bridges, prefabricated span bridges and simple log bridges. When determining a bridge design for multi-use trails, it is important to consider emergency and maintenance vehicle access.

The function of a bridge in an off-road, multi-use trail situation is to provide access to the user over certain natural (i.e. streams) or man-made (i.e., roadways) features.

1. If a corridor already contains a bridge such as an abandoned rail bridge, an engineer should be consulted to assess the structural integrity before deciding to remove or reuse it.
2. A trail bridge should support 6.25 tons.
3. Information about the load-bearing capacity of bridges can be found in the American Association of State Highways and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges.
4. There are many options in terms of high quality, prefabricated pedestrian bridges available. Prefabricated bridges are recommended because of their relative low cost, minimal disturbance to the project site, and usually, simple installation.
5. All abutment design should be sealed by a qualified structural engineer and all relevant permits should be filed.

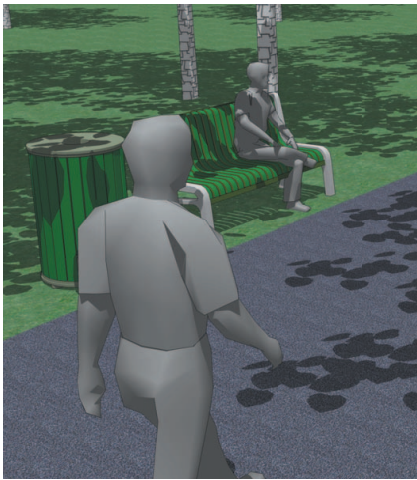


ANCILLARY TRAIL FACILITIES AND AMENITIES

Description

Recommendations

BENCHES



There are a wide variety of benches to choose from in terms of style and materials. Benches provide respite for trail users. The benches are to be placed on either side of the trail facing each other to help frame the trail and encourage social interaction.

Due to a wide range of users, all benches should have a back rest. A bench should normally be 16 - 20" above ground with sturdy handrails on either side. The seating depth should be 18-20" and the length should vary between 60 - 90". Benches should be placed at all trailheads and should normally appear in pairs wherever feasible. They shall be set 2' from the edge of the 2' shoulder, facing the greenway.

OTHER SEATING



Other more informal seating opportunities may exist along a trail or near a parking area where other furniture like a picnic table may be appropriate.

This type of furniture can be triangulated with cooking facilities, and a trash receptacle.

TRASH RECEPTACLES



Trash receptacles should be constructed of a suitable material to withstand the harsh elements of the outdoor environment. Additionally trash receptacles should ensure that litter is contained securely preventing contamination or spillage into the surrounding environment.

Trash receptacles should be placed along the trail and at all trailheads. Adequate trash receptacles will combat littering and preserve the natural environment for all trail users.



WEIGHTED  
GATES*Description*

Weighted gates increase trail safety by providing separation between motorized vehicles and trail users. Installing weighted gates allows for pedestrians and bicyclists to pass through while restricting motorized vehicular access to emergency and maintenance traffic.

*Recommendations*

Gates are typically constructed of painted steel or aluminum.

These should all be painted the same and reflect the overall style of the other greenway site furnishings.

VEHICULAR  
LOCKABLE  
GATES

These types of gates control and prevent vehicular access to parking lots when the parks or trailheads are closed.

Gates are typically constructed of painted steel or aluminum, with halogen or metal halide lights in weather tight casings.

These should all be painted the same and reflect the overall style of the other greenway site furnishings.

## FENCING



Fencing is used to protect users from potential hazards such as steep slopes or restrict access to and from the trail. The style of fence is very important. Chain-link and poorly maintained fencing promotes a negative image and should be avoided.

Use only when necessary and take care to select a style of fencing that does not promote a negative identity.

Also consider landscaping to soften the appearance of fences throughout the greenway and parks.

BICYCLE  
RACKS

There are many types of bike racks available however the two recommended methods are to secure a bike in an enclosed storage, or to lock it to a rack as illustrated here.

A bike rack is recommended as the most inexpensive way to secure a bicycle. An enclosed structure with rented keys is appropriate only in very high bicycle use situations. As illustrated, bike racks can be designed to reinforce a particular design theme. (See the 2008 Wake Forest Bicycle Plan for more on bicycle parking).

TRAIL  
BOLLARDS

Trail bollards are distance markers placed at set intervals. These let folks know where they are on the trail as well as provide important information to those who may be vigorously tracking their exercising. Bollards can also be installed on paved greenways to prevent access by unauthorized vehicles.

Typically these are constructed of either weather treated or stained wood although other materials may be selected. The Wake Forest Greenway logo may be included on these bollards.

## *TRAIL UNDERPASS*

- Typically utilize existing overhead roadway bridges adjacent to streams or culverts under the roadway that are large enough to accommodate trail users
- Vertical clearance of the underpass should be at least 10'; NCDOT only requires 8' minimum vertical clearance.
- Width of the underpass must be at least 12'
- Proper drainage must be established to avoid pooling of stormwater.
- Lighting is recommended for safety.





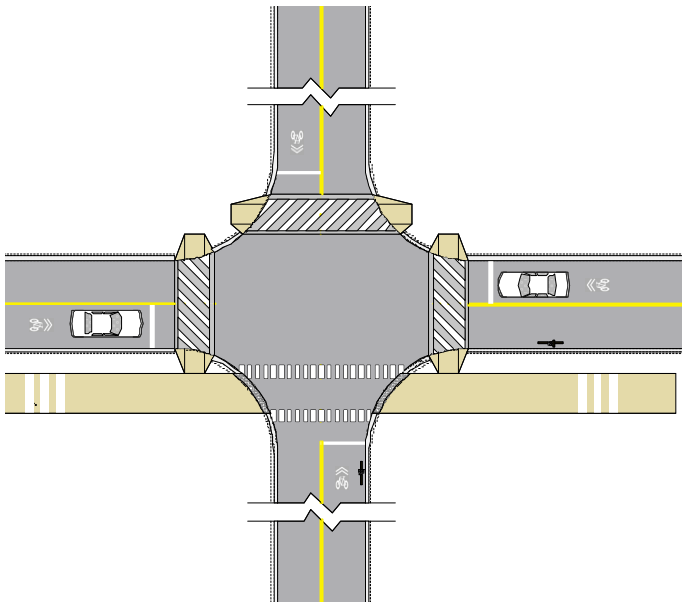
## TRAIL OVERPASS

- Safety should be the primary consideration in bridge/overpass design.
- Specific design and construction specifications will vary for each bridge and can be determined only after all site-specific criteria are known.
- Always consult a structural engineer before completing bridge design plans, before making alterations or additions to an existing bridge, and prior to installing a new bridge.
- A ‘signature’ bridge should be considered in areas of high visibility, such as over major roadways. While often more expensive, a more artistic overpass will draw more attention to the trail system in general, and could serve as a regional landmark.
- For shared-use facilities, a minimum width of 14’ is recommended.
- Trail overpasses are prohibitively expensive and should only be placed in areas of substantial need.

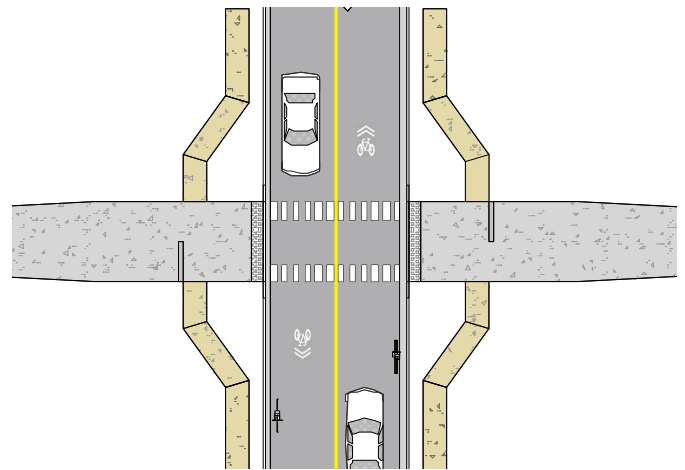


## TRAIL/ROADWAY INTERSECTIONS

- Site the crossing area at a logical and visible location; the crossing should be a safe enough distance from neighboring intersections to not interfere (or be interfered) with traffic flow; crossing at a roadway with flat topography is desirable to increase motorist visibility of the path crossing; the crossing should occur as close to perpendicular (90 degrees) to the roadway as possible.
- Warn motorists of the upcoming trail crossing and trail users of the upcoming intersections; motorists and trail users can be warned with signage (including trail stop signs), changes in pavement texture, flashing beacons, raised crossings, striping, etc.
- Maintain visibility between trail users and motorists by clearing or trimming any vegetation that obstructs the view between them.
- Intersection approaches should be made at relatively flat grades so that cyclists are not riding down hill into intersections.
- If the intersection is more than 75 feet from curb to curb, it is preferable to provide a center median refuge area; a refuge is needed in conditions exhibiting high volumes/speeds and where the primary user group crossing the roadway requires additional time, such as school children and the elderly.
- If possible, it may be desirable to bring the path crossing up to a nearby signalized crossing in situations with high speeds/ADT and design and/or physical constraints.
- In 4-Way Intersection Crossing with Share Use Path (diagram below) – This is also a depiction of a ‘sidepath’ intersecting a roadway. Trail users would navigate this crossing like a common pedestrian.

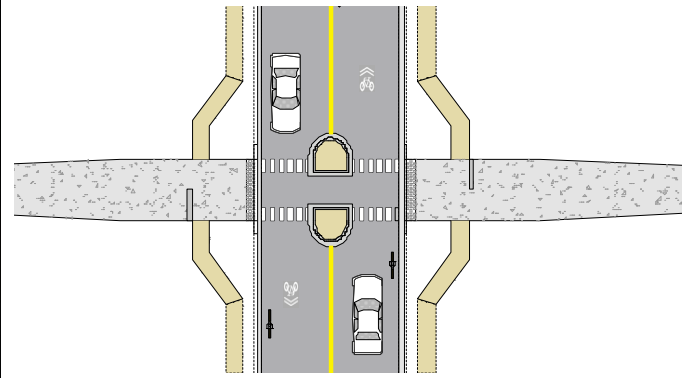


4-WAY INTERSECTION CROSSING  
Shared Use Path

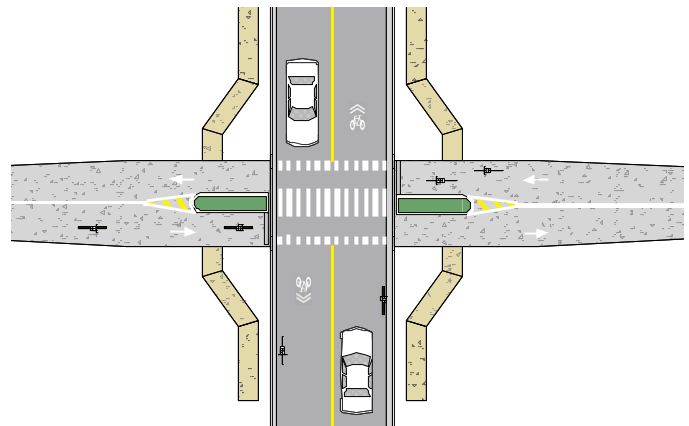


MID-BLOCK INTERSECTION  
Shared Use Path with Sidewalks





**MEDIAN REFUGE**  
Shared Use Path with Sidewalks



**MIDBLOCK CROSSING**  
Shared Use Path with Sidewalks and Medians

### *TRAIL-ROADWAY INTERSECTIONS (SIGNALIZED)*



- Signalized crossings may be necessary on trails with significant usage when intersecting with demanding roadways, but MUTCD warrants must be met for the installation of a signalized crossing. Consult the MUTCD or NCDOT Division of Bicycle and Pedestrian Transportation for signal, sign and light placement.

- FHWA issued an interim approval for the optional use of rectangular rapid flashing beacons (RRFBs, shown at left) as warning beacons supplementing pedestrian crossing or school crossing warning signs at crossings across uncontrolled approaches. An analysis by the Center for Education and Research in Safety found them to have much higher levels of effectiveness in making drivers yield at crosswalks than the standard over-head and side-mount round flashing beacons.



## PUBLIC ART

Explore opportunities to include public art within the overall design of the trail system. These are examples of public art along trails. According to American Trails, “Art is one of the best ways to strengthen the connection between people and trails. Across America and elsewhere, artists are employing a remarkably wide range of creative strategies to support all phases of trail activities, from design and development to stewardship and interpretation. In particular, art can be an effective tool for telling a trail’s story compellingly and memorably.”

Example art programs for trails can be found at:  
[www.americantrails.org/resources/art/ArtfulWays.html](http://www.americantrails.org/resources/art/ArtfulWays.html)

